Frontline

Forestry Research Applications

Forestry Canada, Ontario Region **Technical Note No. 3**

FORESTRY INVESTMENT DECISIONS MADE EASY ON PERSONAL COMPUTERS (FIDME-PC)

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CATEGORY: decision support
KEY WORDS: cost-effectiveness, probability estimates, economic criteria, long-term investment decisions

INTRODUCTION

Most forestry investments are long-term in nature. Thus, they are subject to much risk and uncertainty. Forest-renewal investments are particularly vulnerable to uncertainty, and require the best possible choice of alternatives. To evaluate investment alternatives with ease and precision, forest managers need a technique that not only enables them to predict the costs of production and rates of return, but that also indicates the likelihood that these values will be realized.

A computer program called "Forestry Investment Decisions Made Easy on Personal Computers" (FIDME-PC) was developed to meet this need. The program permits comparisons of up to four alternatives using any or all of four standard economic criteria, *viz.* (1) cost-effectiveness, (2) benefit:cost ratio, (3) present net worth, and (4) internal rate of return. As the name implies, the model runs on MS DOS personal computers, and it makes use of estimates provided by the user on the basis of available data and/or knowledge and experience (Fig.1). Thus, the forest manager is able to evaluate investment alternatives with a known degree of confidence.

A more complete report on FIDME-PC has been published by Payandeh and Basham (1989) and reprints are available from Forestry Canada, Ontario Region. A diskette containing the program, user instructions and input file examples is also available. Forest managers are encouraged to request copies of FIDME-PC from the senior author and to apply it using input data derived from records and experience in their own particular area of concern.

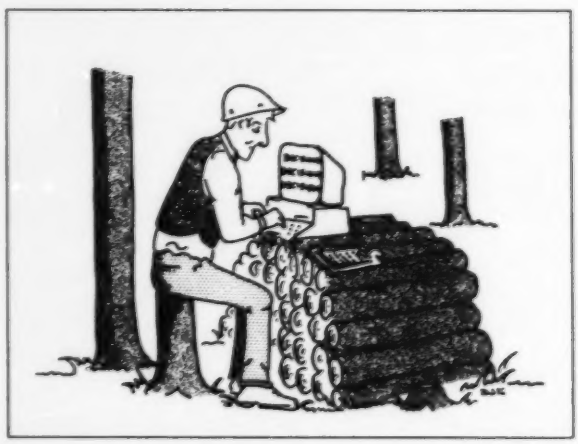

Figure 1. Using the forest manager's estimates, FIDME-PC compares investment alternatives.

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MODEL APPLICATION

To demonstrate the potential of FIDME-PC, a simple example is described, a comparison of the cost-effectiveness of planting versus seeding of jack pine (*Pinus banksiana* Lamb.) to produce pulpwood. This example is typical of the regeneration problems facing the forest manager in boreal Ontario. Managers know from experience that planting costs much more than seeding. On the other hand, the probability of successful regeneration is higher with planting than with seeding, and seeded jack pine stands usually require at least one precommercial thinning at about 10 to 15 years of age. Furthermore, the rotation age for a seeded stand will be up to 10 years longer than for a planted stand; put another way, the yield from a seeded stand will be less than that of a planted stand if both are harvested at the same age. To employ FIDME-PC, the manager provides the necessary input estimates to account for these factors based on his own experience and/or the available records of previous operations.

Estimates: scarification

For this example we will assume that experience has shown the cost of scarification for seeding to be about the same as that for planting. The manager knows that the cost per hectare generally ranges between a low of $130 and a high of $250, and that $120/ha is the absolute minimum that could be expected. From experience, the manager believes that the probability of the cost falling below his low estimate is 10% and that there is a 95% chance it will not exceed his high estimate.

Estimates: establishment

Similar estimates of the ranges of costs, and the probabilities of being within those ranges, are made for both planting and seeding (Table 1). Stocking standards are the same regardless of the method of regeneration used, with 45% the minimum acceptable stocking and 65% or more considered successful. However, the manager knows that there is a higher probability

Table 1. Input estimates for comparing the cost-effectiveness of planting and seeding jack pine to produce pulpwood.

Input	Method of regeneration	Subjective estimates Low	Subjective estimates High	Probability (%) Low	Probability (%) High	Minimum
Site preparation	- plant	$130/ha	$250/ha	10	95	$120/ha
	- seed	$130/ha[a]	$250/ha[a]	10	95	$120/ha[a]
Establishment	- plant	$450/ha[b]	$650/ha[b]	5	95	$425/ha[b]
	- seed	$75/ha[a]	$100/ha[a]	10	90	$60/ha[a]
Stocking standard	- plant	45%	65%	–	–	–
	- seed	45%	65%	–	–	–
Expected stocking	- plant	40%	95%	10	90	30%
	- seed	20%	95%	10	90	0%
Precommercial thinning[c]	- plant	–	–	–	–	–
	- seed	$250/ha[a]	$400/ha[a]	10	90	$225/ha[a]
Yield	- plant	200 m³/ha	300 m³/ha	10	95	150 m³/ha
	- seed	150 m³/ha	250 m³/ha	10	95	120 m³/ha

Economic criterion: cost-effectiveness
Rotation age: 70 years
Interest rate: 8%
Inflation rate: 3%
No. of iterations: 300

[a] based on Vassov and Baker (1988)
[b] includes cost of planting stock
[c] takes place at age 12

of success with planting than with seeding. He estimates that the expected stocking range is 40 to 95% for planting, with an absolute minimum of 30%. For seeding jack pine, the comparable figures are 20 to 95% for the expected range of stocking and zero for the absolute minimum. For both regeneration systems, the manager judges that there is a 90% chance that stocking will be within the expected ranges and only a 10% chance that it will be below the low estimates.

Estimates: yield

For both planted and seeded stands, it has been assumed that harvesting will take place at 70 years and the product will be pulpwood. For the planted stand, the low estimate of the expected yield is 200 m^3/ha, the high estimate is 300 m^3/ha, and the minimum is 150 m^3/ha. The probability that the yield could fall below the low estimate is 10% and the probability that it will be less than the maximum is 95%. As noted earlier, seeded stands can be expected to yield somewhat less wood than planted stands harvested at the same age. For the seeded stand, the low estimate of the expected yield is 150 m^3/ha, the high estimate is 250 m^3/ha and the minimum is 120 m^3/ha. The probabilities of the yield being within this range are assumed to be the same as for planting.

Other input estimates required for this example are cost ranges and probabilities for precommercial thinning, interest rates and the rate of inflation. These and the other input estimates are summarized in Table 1.

RESULTS AND INTERPRETATION

The example described is a hypothetical case, and the results presented in Table 2 do not constitute a recommendation of one regeneration system over another. The output could also change significantly with a change in input estimates.

The numbers in Column 2 of Table 2 exceed those in Column 3 in every case, suggesting that it would be more cost-effective to seed than to plant, notwithstanding the added cost of precommercial thinning and the lower yield from seeded stands. Evidently, these are more than offset by the high cost of planting (which includes the cost of stock).

The first column of Table 2, "Probability of exceeding", applies to the remaining columns in the table. For example, the fourth row indicates that there is only a 30% chance that the cost of producing pulpwood will exceed \$87.79/m^3 in the seeded stand and \$109.28/m^3 in the planted stand. Conversely, there is a 70% chance that the costs will be equal to or less than these figures.

Table 2. Sample output from the FIDME-PC model, comparing the cost-effectiveness of planting and seeding jack pine to produce pulpwood at a rotation age of 70 years, with an interest rate of 8% and an inflation rate of 3%.

	Future cost (\$/m^3)	
Probability of exceeding	Planting	Seeding
0.00	290.48	185.67
0.10	154.2	112.64
0.20	125.94	95.96
0.30	109.28	87.79
0.40	99.28	81.77
0.50	89.80	75.47
0.60	83.79	70.57
0.70	78.43	66.17
0.80	72.78	61.11
0.90	67.45	56.68
1.00	49.94	38.95

SUMMARY AND CONCLUSIONS

For the sake of brevity, only one comparison (planting versus seeding), on the basis of only one economic criterion (cost-effectiveness), was presented in this note. However, FIDME-PC has the capability of making up to four comparisons at one time using any one of four common economic criteria, viz. cost-effectiveness, benefit:cost ratio, present net worth and internal rate of return. The model runs on MS DOS personal computers using input data provided by the user on the basis of relevant records and experience. Furthermore, changes in input estimates can be made readily, enabling the manager to quickly assess the impact such changes might have on the outcome of investment decisions. FIDME-PC is recommended as a useful tool to assist the forest manager in making long-term investment decisions.

REFERENCES AND FURTHER READING

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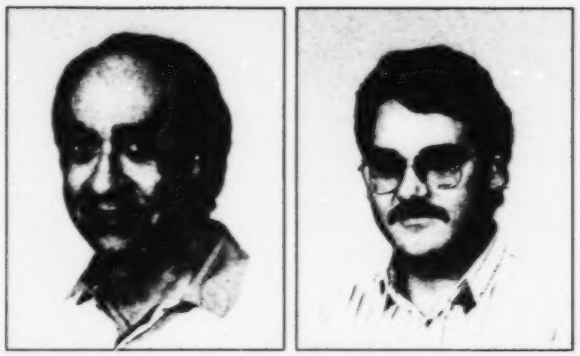

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